

# Incidence of oxygen desaturation with intravenous ketamine and the effects of the basic airway management maneuvers on it

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## ABSTRACT

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**Introduction:** This study was conducted to evaluate and compare the incidence of oxygen desaturation during intravenous ketamine for short surgical procedure and the effects of basic airway management maneuvers during desaturation.

**Methods:** A Population based comparative study was done at two different hospitals situated in hilly regions of Nepal. Children aged between 3 months and 14 years were observed for their oxygen saturation with the help of Pulse Oxymeter during intravenous ketamine anesthesia for short surgical procedures lasting less than 15 minutes.

**Results:** Seventy nine patients from United Mission Hospital (UMN), Tansen and 66 patients from Okhaldhunga Community Hospital (OCH), Okhaldhunga were enrolled; the incidence of desaturation was 8(10%) and 11(16.1%) in Tansen and Okhaldhunga respectively. 7(87.5%) and 8(72.7%) of the patients with desaturation from UMH and OCH respectively, were improved to >90% with chin lift only and rest needed jaw thrust.

**Conclusion:** The incidence of oxygen desaturation is common within first few minutes of ketamine administration. Basic airway measures like chin lift and jaw thrust is enough to improve oxygen saturation.

Key Words: *Ketamine, Oxygen Desaturation, Basic Airway Measures*

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**INTRODUCTION**

Nepal is a mountainous country, and almost half of the population resides within the range of 600-4500 meter altitude.<sup>1</sup> High altitude is obviously associated with low barometric pressure and low oxygen partial pressure. Ketamine is widely used throughout the world especially in precarious condition, like battlefield<sup>2</sup>, disaster, pre-hospital trauma victims<sup>3,4</sup>, where resources are minimal. Provision of oxygen is usually considered mandatory in any anesthetized patients. But oxygen supply to remote areas of Nepal is difficult due to various reasons like cost factor, infrequent supply and lack of transportation. These are the factors that limit the use of ketamine in the rural hospitals of hilly areas of Nepal. Small case series done at 3900m altitude from Nepal<sup>5</sup> showed that supplemental oxygen was not required in healthy acclimatized patients. Similarly Pesonan also used ketamine successfully without any supplemental oxygen at an altitude of 6000ft for short procedures.<sup>6</sup>

Tansen is situated at 1361m western part and Okhaldhunga is situated at 1800 m above sea level, eastern part of Nepal.<sup>7,8</sup> The concept of basic airway management maneuvers like chin lift, jaw thrust, physical stimulation and oro-pharyngeal suction has been documented only in few papers discretely<sup>6,9</sup>, but whether these maneuvers are really effective when solely applied in a systematic way, is still not answered. This study will evaluate the incidence and magnitude of oxygen saturation changes with intravenous ketamine for short surgical procedure lasting less than 15 minutes and will try to answer the effectiveness of different basic airway maneuvers to correct desaturation in the children population residing in hilly areas of Nepal.

**METHODS**

This comparative study was done at Tansen Mission Hospital, 165 bed hospital situated at an altitude of 1361 meter located in western part of Nepal, and at Okhaldhunga Community Hospital, Okhaldhunga, 32 bed hospital situated at an altitude of 1800 meter located in eastern Nepal. The study was conducted from May 2007 to October 2007. Children age between 3 months to 14

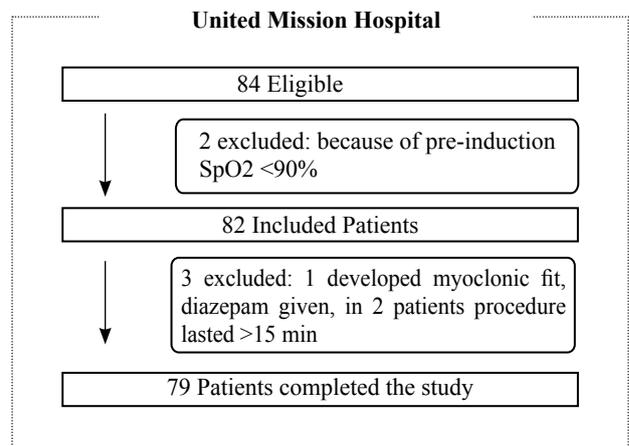
years or less undergoing short surgical procedures with intravenous ketamine anesthesia were included. Patients were excluded if premedicated or supplemented with medicines other than intravenous antibiotics; procedures lasted more than 15 minutes, patients having pre-existing heart or lung disease, oxygen saturation less than <90% before intravenous ketamine administration.

After administration of ketamine (at 2 mg/kg) SpO<sub>2</sub> was recorded at every 2 minute interval throughout the procedure and full recovery. Maintenance dose of intravenous ketamine were given at a dose of 0.5-1 mg/kg if necessary.

Patient breathed room air throughout the procedure and recovery. Manual basic airway procedure like chin lift, jaw thrust, oro-pharyngeal suction and physical stimulation were used, in those whose oxygen saturation drops below 90%, one after another for 15 seconds for each maneuvers. Physical stimulation was used when desaturation was associated with slow breathing or apnea. Oropharyngeal suction was used when desaturation was associated with increase oropharyngeal secretions. Supplemental oxygen was used only after 1 minute when all the maneuvers failed to improve initial oxygen desaturation with the help of mask in order to restore SpO<sub>2</sub> above 90%. Patients needing any of the maneuvers or supplemental oxygen were recorded by Principal Investigator.

Ethical clearance from Nepal Health Research Council was obtained for the study.

**RESULTS**



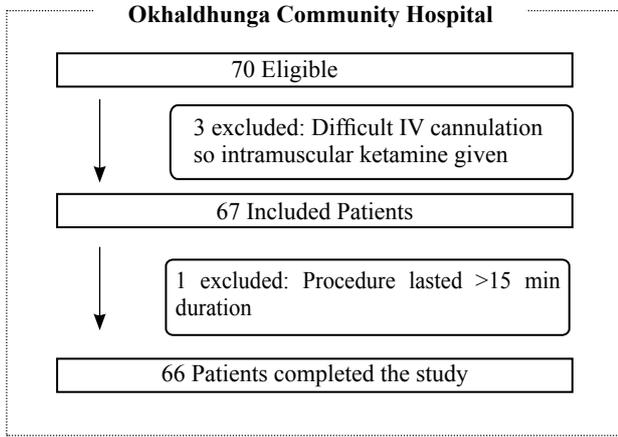


Figure 1. Flowchart showing the study profile

	TMH (n=79)	OCH (n=66)	P value
Age, yrs (SD)	6.5 (±3.4)	7.9 (±4.6)	0.059
<1	6	4	
1-5	26	23	
5.1-10	35	13	
10.1-14	12	26	
Weight, Kg (SD)	17.4(±6.6)	19.6(±9.0)	0.107
Sex			0.683
Male	54(68.3%)	41(62.1%)	
Female	25(31.6%)	25(37.8%)	
Procedures			
Fracture reduction	43	24	
Incision and drainage	9	18	
Debridement	6	8	
Wound closure	4	4	
Others (Pin removal or insertion, LP, FB removal, STSG etc)	17	12	
Duration of Procedure (min)	9.13(±3.1)	9.59(±2.8)	0.349

Table 1: - Baseline characteristics of the patients.

	TMH(n=79)	OCH(n=66)	Pvalue	
Pre-induction SpO2 (mean)	96.2%	96.4%	0.536	
Post-induction SpO2				
<89%	0	1		
>90%	79	65	0.455	
During procedure (T=TMH, O=OCH)				
	0-2 min	3-4 min	5-10 min	11-15 min
	T/O	T/O	T/O	T/O
>90%	71/57	79/66	79/65	79/66
80-89%	8/8	-/-	-/1	-/-
70-79%	-/1	-/-	-/-	-/-
<69%	-/-	-/-	-/-	-/-
Post-operative SpO2 at 20 min				
<89%	-	-		
>90%	79	66	0.11	
Post-operative SpO2 at 30 min				
<89%	-	-		
>90%	79	66	0.17	

Table 2: Recording of oxygen saturation changes

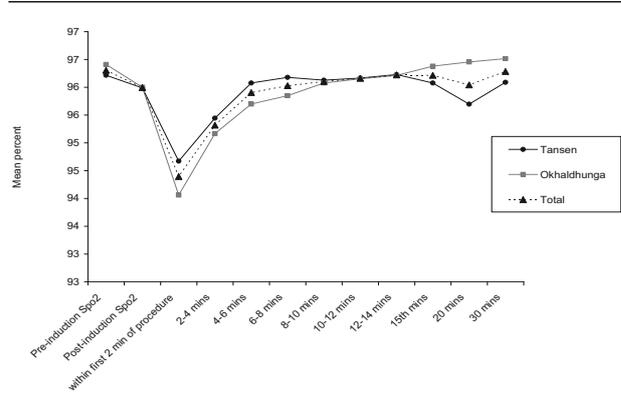


Figure 2: Showing magnitudes of mean SpO2 changes with ketamine anesthesia in UMH, OCH and in combined number of cases from both centers.

Significant difference noted between pre-induction and within first 2 minutes of procedure (P value <0.001) in magnitudes of changes.

- Chin Lift    ▨ Jaw Thrust    □ Oropharyngeal Suction
- ▩ Oxygen Supplementation    □ Physical Stimulation

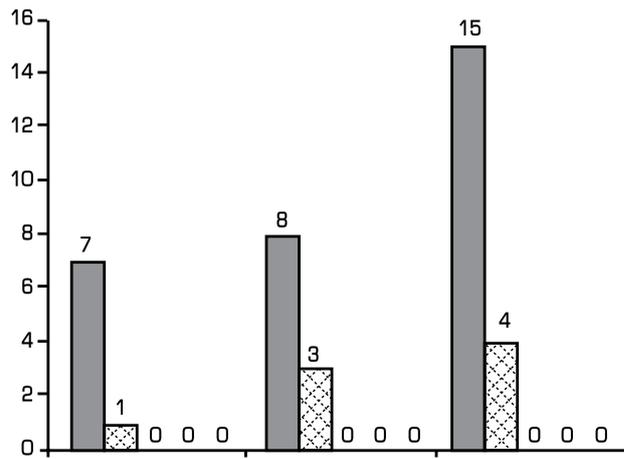


Figure 3: - Graph showing the number of patients with desaturation where oxygen saturation was successfully corrected to >90% with different min airway maneuvers

## DISCUSSION

This study has demonstrated that the incidence of desaturation with intravenous ketamine is common and simple basic measures if done in a systematic way can correct these problems. The incidence of oxygen desaturation was recorded to be 10.12% in Tansen and 16.66% in Okhaldhunga, consistent with the findings of Goor, and Joly, 10% and 18% respectively.<sup>10,11</sup> The lowest

SpO<sub>2</sub> recorded was 79%, but rest of all children (n=18) who had desaturation, the SpO<sub>2</sub> values were within 80-90% in both the study centers. The baseline oxygen saturation found to be 96% in both centers; the mean age and mean duration of procedure are also similar in both sites.

In this study 94.72% out of 19 children, desaturation occurred within first 2 minutes of ketamine, except in one which occurred at 7<sup>th</sup> minutes. This was clearly a significant drop (*P* value <0.001) compared to pre-induction and post-induction SpO<sub>2</sub> values, but mean SpO<sub>2</sub> values returned to near baseline immediately after applying basic maneuvers. Streatfield<sup>12</sup> and other studies<sup>6,11,13</sup> have also shown that desaturation is common within initial few minutes of IV ketamine administration. Literatures have reported that rapid intravenous administration can be associated with desaturation.<sup>2,14</sup> This factor was ruled out as the drug was administered slowly over 45-60 seconds in this study. As reported by Pederson<sup>6</sup>, children exhibit only infrequent, brief, clinically insignificant hypoxaemia. The onset and duration of falls in oxygen saturation are likely to be related to the pharmacokinetics of ketamine, which peak plasma concentration is within 1 minute of IV administration. As documented by Joly<sup>11</sup> desaturation may be partly related to airway obstruction but also to central ventilator depression which is more pronounced when ketamine is used as bolus, desaturation is less severe and less frequent in children than in adult. We found no desaturation during recovery period.

We found that chin lift maneuvers is very much effective in correcting oxygen desaturation and jaw thrust maneuvers as second effective measure. Jaw thrust has been tried successfully for restoration of airway malalignment during desaturation.<sup>5,15</sup> Bishop<sup>5</sup> recommended physical stimulation (vocal and tactile stimulus) to correct the oxygen desaturation, because according to him it encourages the patients to breathe faster and deeper. In Tansen 7 out of 8 cases with desaturation were corrected simply with chin lift only and one needed jaw thrust, whereas in Okhaldhunga 8 cases were corrected with chin lift and remaining 3 needed jaw thrust. Noteworthy, almost 80% of the children with desaturation were corrected with chin lift only in both centres, though

statistically not significant (*P* value 0.342). But none of the patients needed physical stimulation, oro-pharyngeal suction and supplemental oxygen.

This study has clearly shown that none of the patients required supplemental oxygen even though the study was done at hilly areas. The finding is similar with Pederson<sup>6</sup> case series, where patients with desaturation were not given oxygen. The result is also against the recommendation by Joly and Benhamou for routine oxygen supplementation for at least first 15 minutes for all patients after induction.<sup>11</sup> Moreover, this study supports ketamine anaesthesia induction without supplemental oxygen and episodes of desaturation can be managed with vigilant observation and skilled management, as supported by other literatures.<sup>6,13,15</sup>

Among total children, we noted 6 children with transient jaw clenching, out of which 4 were associated with desaturation, but without further respiratory complications. This was also reported by Pederson<sup>6</sup> in his case series. These spasms may be result of exaggerated laryngeal and pharyngeal reflexes, which is the feature of ketamine<sup>2,16,17,18</sup>, and from the animal studies it has been suggested that laryngospasm is self-limiting in nature because the occurrence of hypoxia or hypercapnia will result in spontaneous relaxation of the glottis.<sup>2,19</sup>

There were some oral salivary secretion noted in 2 (3.3%) patient during procedure at Okhaldhunga and in 2 (2.5%) patient during recovery at Tansen, similar with general incidence of 1.7%<sup>4</sup>, but they were not significant to cause airway obstruction as there was no desaturation. This finding support that the routine use of anti-sialogogue in children during ketamine anesthesia for short surgical procedure is un-necessary and further stresses the importance of basic airway management. We found none of our patient had apnoea. Literatures have shown that incidence of laryngospasm is less than 1% in children and apnoea is exceptionally rare.<sup>3</sup>

The limitations of this study were that the statistical calculation for sample size was not done before the study, no blinding was possible and only children were included, so whether the findings is relevant for adults is still questionable.

## CONCLUSION

When using intravenous ketamine as anesthesia, desaturation is a common problem, which appears especially within first few minutes of its administration, but remains in steady baseline level throughout the procedure after the initial drop. In patients with desaturation, chin lift and jaw thrust is enough to improve saturation and physical stimulation, oro-pharyngeal suction and most importantly supplementary oxygen is not required for short surgical procedure lasting less than 15 minutes.

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